WOOL

Serial 469 Edition 1

INTRODUCTION

CLASSIFICATION OF TEXTILE FIBERS

1. In order that one may be able to obtain a thorough and comprehensive knowledge of the methods and processes employed in converting any textile fiber into yarn, it is first necessary that the structure of the fiber and its peculiarities shall be thoroughly understood. Especially is this true in regard to wool, which possesses certain peculiarities not shared by any other textile fiber; nor is it sufficient for one engaged in woolen manufacture to understand the wool fiber alone, since cotton, silk, and other fibers are often used in woolen mills in connection with the fiber obtained from the fleece of the sheep.

2. Animal and Vegetable Fibers.—The various fibers used in textile manufacturing are, on account of their origin and the marked difference in their physical and chemical properties, divided into two great classes; viz., **animal** and **vegetable fibers.** To the animal class belong the wool of the sheep and the wool-like hair of certain species of goats and animals of an allied nature, as well as the furs of certain other animals that are used for manufacturing purposes. Another notable member of the animal class of fibers, and one that is second only to wool in importance among the animal fibers, is the silk fiber. The most important member of the vegetable class of textile fibers is the cotton fiber, and then follow, in about the order given,

linen, hemp, jute, and china grass, or ramie, fiber, as well as many fibers of minor importance.

3. Mineral Fibers.—A third class of textile fibers is sometimes made under the head of **mineral fibers.** These include such fibers as asbestos, glass wool, etc., but as these are used only for steam packings, and boiler and pipe coverings, etc., and are such an unimportant portion of the textile industry, no further mention will be made of them.

4. Difference Between Animal and Vegetable Fibers.—As previously stated, the difference between animal and vegetable fibers is marked. Generally speaking, the vegetable fibers are smoother and more pliable than the animal fibers, especially wool, which has a rough, curly nature in comparison and a certain elasticity not possessed by any vegetable fiber.

The difference between the two great classes of fibers is even more marked chemically than physically. Vegetable fibers are composed largely of cellulose, and when burned are readily consumed—leaving a very small percentage of white ash and emitting practically no odor during combustion. Animal fibers may be said to have a nitrogenous chemical structure and are burned with some degree of difficulty, emitting during combustion a pungent odor characteristic of burnt horn or feathers, and leaving a charred, globular residue. Vegetable fibers resist the action of alkalies but are readily destroyed by acids, while animal fibers suffer no deterioration from the action of the mild acids but are quickly destroyed by alkalies. The principal animal fiber, wool, has a rough, serrated surface, is curly, or longitudinally wavy, and is disposed on the fleece in locks, technically **staples,** which are composed of a large number of individual fibers. When placed under a microscope and magnified to several hundred diameters, the appearance of various fibers is seen to vary in

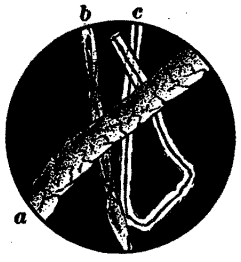

FIG. 1

a marked degree. In Fig. 1, a view is shown of a wool fiber *a*, a cotton fiber *b*, and a silk fiber *c*, as they appear when greatly magnified.

5. Hair.—Not only do animal and vegetable fibers differ in physical and chemical structures, but there is also a marked difference in physical structure between certain of the animal fibers. **Hair** has a smoother surface than wool, is straighter, and is not combined in staples, as each fiber grows individually. Between hair and wool, however, there are many gradations, and certain long hair-like fibers are disposed in staples and are commercially classed under the head of wools when, strictly speaking, they should be included among the hair products. An instance of this kind is the case of *mohair*, which, although often classed as wool, is really the long silky hair of the Angora goat. Another instance is that of the so-called *vicugna* wool, which is the product of the vicugna, an animal native to South America and belonging to the same genus as the llama.

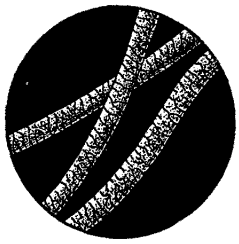

FIG. 2

It is supposed that originally, when wild, all animals were either hair-producing in their nature, or else were covered with fur, which is in reality fine, thick hair. True wool, as typically illustrated by the fleece of the sheep, is the product of breeding and cultivation, the hairy covering of the wild animal gradually becoming more like wool in its nature in direct proportion to the care bestowed on it and the degree to which it is domesticated. Sheep, if neglected and exposed to inclement weather, show a tendency to revert to their supposed former hairy covering, and the fiber becomes shorter, straighter, and coarser, until sometimes, in high latitudes, it very closely resembles hair.

In Fig. 2, a microscopical view of hair fiber is shown, from which it will be seen that the hair fiber is somewhat different in physical structure from the wool fiber shown in Fig. 1.

THE WOOL FIBER

MODE OF GROWTH

6. Wool may be said to be a term that, in its strictest sense, applies only to the fleece or covering of the sheep, but which is often extended, for purely commercial reasons, to include certain other animal fibers that are more properly included under the term *hair*. Wool is an epidermal growth of the sheep, and its character depends on the breed of the sheep, the trueness of the breeding, and the locality in which the wool is grown.

The mode of growth of a wool fiber may be seen by referring to Fig. 3, which is a section of the root of a single fiber. The root of the fiber is enclosed in the *hair follicle*, which is a minute sac formed in the skin of the sheep. The skin itself consists of four layers: an outer, or *scarf*, skin composed mostly of dried or dead cells; the *epidermis*, or true skin; a *papillary layer*, filled with minute blood vessels; and finally the *dermis*, or *corium*.

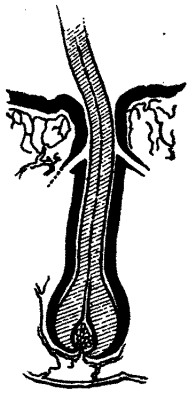

FIG. 3

The wool fiber is formed in the hair follicle and is pushed out through the skin in a somewhat plastic form, which, however, soon hardens into the true fiber. The fiber itself is formed of three distinct portions: In the center is a medullary canal like a pith, which is formed of soft, globular cells; surrounding this is a layer of elongated and somewhat spindle-shaped cells, which form the bulk of the fiber; and surrounding the whole is a layer of flattened, horny scales or cells, which in a healthy sheep have a high luster. These outer scales form a complete covering for the fiber and are fastened nearer the root end, the top of each scale,

or portion near the tip, being free and projecting somewhat from the body of the fiber. The scales are overlapped, so that the appearance of a typical wool fiber may be compared to an elongated fir cone. The scales form what are known as the **serrations,** or **imbrications,** of the wool fiber, and are one of the prime causes of the great felting or milling power possessed by wool, and by no other fiber to such a marked degree. It is this felting power that enables a woolen cloth composed of suitable wool to be so amalgamated that one fiber joins another fiber, producing a firm, thick fabric, the distinct individuality of the component threads of the fabric being lost.

The scales of the fiber may be readily noticed by drawing it through the fingers from point to root. If the fiber is drawn in the opposite direction, that is from root to point, it will feel perfectly smooth to the touch, since, as previously stated, the scales project from the fiber in the direction of the point. An idea of the appearance of the scales may be obtained by referring to Fig. 1, where the wool fiber shown may be said to be typical of its kind.

PROPERTIES OF WOOL

7. Felting.—On the number of serrations, together with the natural curly, or wavy, nature of the fiber, the value of any wool as a felting wool largely depends. **Felting,** which is a quality possessed in a marked degree by wool only, may be said to be the amalgamation or matting of the fibers of wool. The small teeth-like projections of one fiber catch into those of its neighbor and become locked together, this being helped by the curly nature of the fiber inclining it to twist around anything that is near. Under pressure and in the presence of some lubricant, such as soap, warm water, etc., the fibers of wool become matted together and identified with one another. This is exactly what happens when a woolen cloth is milled. The cloth is under pressure and in the presence of warm water and soap. Under these conditions, the dried-up cells that form the scales on the

surface of the fiber become softened; the serrations of one fiber become interlocked with those of the next; and the threads of the fabric become amalgamated to such an extent that they can with difficulty be separated. This process of felting, or milling, is accompanied by a shrinkage and the fabric *takes up*.

In order that felting may take place, it is essential that some of the fibers lie in one direction while others point in the opposite; this object is always accomplished during the manufacture of the yarn, by the repeated mixing and blending to which the fibers are subjected. In Fig. 4, a longitudinal section of two wool fibers is shown, which illustrates the method by which the serrations of one fiber become interlocked with those of another. This illustration is, of course, out of proportion, but it will be readily noticed that the fibers must be inclined in opposite directions in order to felt. If they were both arranged side by side with roots and tips together, the serrations of one fiber would readily slide over those of the other fiber, no matter in what direction the fiber was moved.

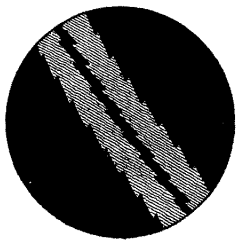

FIG. 4

Although the serrations of the wool fiber are a prime cause of its felting power, it must be remembered that the curliness and elasticity of the fiber also influence the felting of the wool. Neither the curliness nor the elasticity, however, is the sole cause of felting, as some fibers, like mohair for instance, have a beautiful crimp, or curl, but owing to the lack of sufficient serrations on the fiber, are extremely difficult to felt.

8. The felting value of a wool is largely determined by the number of serrations per inch of the fiber and also by the freedom with which the upper edge of the scale projects from the fiber. The freer the movement of the scale and the more it sticks out from the body of the fiber, the greater is the felting power. For this reason, it has been found that wool fibers

that have been treated with acids or other agents (as for instance, in the process known as **carbonization**, or **extraction**) have a greater felting power than the same fibers before being treated. The acid or other agent seems to open out the scales of the wool so that the fibers are more easily felted. For the same reason, what are known as **pulled wools** (that is, wool that is removed from the skin of dead sheep by first soaking the pelts in, or rubbing the back of the skin with, lime or acid) are often better felting wools than the same grade clipped from a live sheep; the lime or acid, instead of injuring the fiber, actually, increases its felting properties by abnormally extending the scales.

Wool rarely felts on the sheep, owing to the fact that the serrations are filled with a natural grease known as **yolk**, and also because, when on the sheep, the scales all point in one direction; that is, from the root toward the point of the fiber, the root of the fiber being fast in the skin of the sheep. Occasionally, however, in the case of a sick sheep, the wool will felt on the sheep's back in patches, which are called **cots**. These are especially apt to occur on old sheep, particularly ewes 6 or 7 years old, and are due to a scanty supply of the animal grease, or yolk, at the places where the cots occur.

Wool, except for the manufacture of hats and felts, is usually felted or milled after it is spun and woven into cloth, but may sometimes become felted accidentally unless great care is taken at other stages of its manufacture, notably in the scouring process. So remarkable are the felting or fulling properties of some wools, that it is only necessary to beat them in order to form a felted fabric. As a rule, short wools are better felting wools than those of longer staple, since they are usually richer in serrations and generally finer in fiber.

9. Serrations.—Enough has been said (in connection with the structure, mode of growth, and felting power) concerning the serrations, or imbrications, of the wool fiber, to give a knowledge of what is meant by the terms.

Nothing has been said, however, in regard to the number of serrations on the wool fiber, except that the more numerous the serrations, the more valuable is the wool for fulling purposes. The number of serrations per inch of various wools vary from a few hundred to several thousand; in a general way it may be said that the longer and coarser the wool, the fewer are the serrations. The Saxony Electoral wool, which has superb fulling qualities, contains as high as 2,800 serrations per inch, while Australian merino, which also possesses excellent felting properties, has 2,400 serrations per inch. Some of the fine full-blooded merino sheep raised in Vermont for breeding purposes only, are said to have as many as 3,000 serrations per inch. The English Southdown has about 2,000 serrations per inch, while Leicester, a wool of acknowledged inferior felting power, has only 1,800 serrations per inch. While it is true that some wools have even fewer serrations than Leicester, their value as fulling wools is very slight.

10. Softness and Fineness.—These are two very important properties that are necessary in a wool for producing the best grades of cloth. The **softness** and **fineness** of wool vary according to the breed of the sheep and to the state of cultivation to which it has been brought. As a rule, short wools are finer and softer than long wools; but this does not hold true in all cases, since some long wools are very fine and soft, while some short wools are harsh, coarse, and wiry. This, however, is not generally the case. The finer the wool fiber is in diameter, the softer is its feeling. No wool can be soft without a plentiful supply of the natural animal grease or yolk, without which it has a harsh, brashy feeling.

The finest wool is known as **lamb's wool** and is clipped when the animal is about 6 months old. The fiber of lamb's wool also gradually tapers to a point, while wool that has been previously shorn has a blunter point. The second clip, or yearling wool, made when the sheep is about 1 year old, is also somewhat finer than the subsequent, or

fleece clips, although extremely fine-fibered wools are produced among these. There is a great difference in the softness and fineness of wool according to the portion of the fleece from which it is obtained. This subject is properly included under the head of Wool Sorting, and will be taken up later.

There is considerable difficulty in making accurate measurements of the actual diameter of the fiber, on account of its extreme fineness, and also because of the irregular shape of the section, the fibers being round in some instances and elliptical in others. Saxony Electoral wool, one of the finest and best-grown wools in the world, has been found to be about $\frac{1}{2000}$ inch in diameter, varying from this to $\frac{1}{1600}$ inch. Some of the long braid wools are as coarse as $\frac{1}{400}$ inch in diameter, while selected breeding specimens of the Vermont merino are said to run even finer than the Saxony, being known in some instances to approximate $\frac{1}{3000}$ inch, although it is doubtful if this is not an exceptional case. The Australian merino is said to average from $\frac{1}{1400}$ to $\frac{1}{1200}$ inch in diameter, while the breed of sheep known as Southdowns produce a slightly coarser fiber, being about $\frac{1}{1100}$ inch in diameter.

11. Strength and Elasticity.—Wool, in order to produce cloth of the highest grade, must possess **strength** and **elasticity.** Wool is one of the most elastic fibers known to the textile industry, and for this reason is unrivaled in the production of cloth with a *lofty feel*; that is, cloth having that full, soft, elastic *handle* so much desired by the commission house and buyer. The elasticity of wool is no doubt due in some degree to the curly, wavy nature of the fiber, as well as to its natural structure.

To illustrate the elasticity of wool, as compared with other fibers, take a handful of clean, dry, Australian merino, or other high-grade wool, in one hand and compress it into as small a space as possible; then release the pressure, and the wool will resume its original shape. Try this same experiment with a handful of cotton, and it will be seen that the

cotton, after being compressed, will remain in a more or less inert lump, and will not spring back like the wool. When a wool fiber is subjected to tension instead of compression, it is found that the elastic limit, after which it will not return to its original length, is reached after the fiber has stretched from .3 to .5 per cent. of its length. A single wool fiber will support from .5 to 1.25 ounces, depending of course on the fineness of the fiber. Both the breaking weight and the elastic limit, however, will be found to vary greatly with different samples of wool. The strength and elasticity greatly aid in the manufacture of woolen cloth, especially in the spinning of the yarn. That they play an important part in the quality of a fabric is shown by the superior strength and feeling of a piece of pure woolen goods as compared with a fabric manufactured from, or adulterated with, either cotton or cheap wool substitutes.

12. Crimp.—The crimp, or curliness, of the wool is another important factor in its value, since this quality of the fiber aids not only its elasticity but, to a certain degree, the felting power of the fiber. A curly fiber is a great aid in spinning the wool, since it can be drawn finer and a more compact and rounded thread formed. By reason of the curly nature of wool, it is possible to spin a thread containing a very few fibers in its cross-section. Generally speaking, it may be said that the more crimps per inch there are in the fiber, the finer is the wool; that is, the diameter of the fiber. This is not a universal rule as is supposed by some, but serves, however, in the majority of cases as an indication of the diameter of the fiber.

The number of crimps per inch in the wool fiber vary from twenty-eight or thirty in fine wool, as for instance Saxony and merino, to only one or two in coarse carpet wools. While the crimp of the wool fiber is permanent, it is altered somewhat by the amount of moisture in the fiber, and may be taken entirely out by stretching the fiber in hot water. After drying, however, the crimp usually returns, and the fiber assumes its former shape.

13. Soundness.—Perhaps one of the qualities of a wool most desirable to the manufacturer is **soundness** of the fiber. If the sheep have been ill-kept, neglected, exposed to inclement weather, or pastured on ranges where the feed is insufficient, the growth of the wool is stunted and its quality deteriorated. Such a flock will often produce what the buyer terms **tender staple;** that is, the fibers are weakened and are not so strong as the average wool. If a sheep is neglected and starved, even for a few days, there will be a corresponding thin, weak place in the wool, where its growth was stunted during the neglected period. This weak place will remain in the fiber even after the wool has continued to grow. It is said that the most expert buyers can, if there is a weak place in the staple of a lot of wool, tell the month in which the drought that caused it occurred.

It is a well-known fact that alkalies are detrimental to wool; and when a flock of sheep habitually range on an alkaline soil, the fiber will be somewhat weaker than the average. The wool fiber should taper slightly from the root to the tip; but sometimes where sheep are exposed to rough weather, the fiber will thicken up at the tip where it is exposed, and still remain fine near the root, where it is protected from the weather.

Wool being somewhat fibrous and porous, the fiber is easily split; indeed, when the sheep is sick, the fibers often split from the tip toward the root. If the wool is very dull in appearance it is apt to be tender. Sound wool is bright, lustrous, and moderately greasy, or yolked. After a sheep has passed a certain age, say 6 or 7 years, the wool produced is apt to be tender, as well as somewhat deficient as regards yolk.

In testing wool for tenderness, a small lock or staple is taken and its strength tried. It can easily be seen if the wool is weak to any great extent, as it will always break in about the same place.

14. Kemps.—In fleeces from neglected or poorly bred sheep there occur certain bright, shining, straight hairs called

kemps. These hairs are wool fibers that appear to be diseased or dead. They are straighter than the ordinary healthy fiber, and when viewed under the microscope do not show the characteristic scales or serrations of the wool fiber to such a marked extent. Kemps are more or less opaque, while the ordinary wool fiber is somewhat translucent. They occur even in highly bred wool, such as Saxony and merino, but are much more frequently met with among the lower-grade and cross-bred wools. They generally occur about the neck and legs, where the wool gradually merges into hair.

Kemps vary in length, being in some sheep 2 inches long, or even more in some cases. In brown or dark-colored sheep the kemps are black, but in most cases they are white. They never unite with the other wool in forming a thread, but are simply held in place by the other fibers, and on the surface of the cloth will be seen as straight, shining hairs pinioned down by these fibers. In the dye bath, kemps will not dye the same shade as the other fibers, owing to the fact that they do not absorb the dyestuff as readily. This causes them to show up prominently in the finished goods, thus greatly deteriorating the fabric. By careful breeding and care in housing the sheep in cold and stormy weather, the condition of kempy sheep may be greatly improved.

15. Color.—In regard to color it may be said that, generally speaking, the whiter the wool, the more highly it is prized, although there are certain shades of natural browns and black wools that are often sought after. The color is not of so much importance as other qualities, unless white or delicately colored goods are to be produced. The majority of wools are white, but there are produced in small quantities brown, black, red, gray, and yellow. The color of the wool is sometimes influenced by the character of the soil on which the sheep ranges.

16. Luster.—Luster may be defined as the bright, or shining, quality possessed by wool in a marked degree. While wool is not as lustrous as silk, it is far more so than cotton. The luster of the wool fiber appears to be due to the

reflection of light from the horny scales that surround the fiber. As a rule, long and coarse wools are more lustrous than the finer and shorter wools. This is due to the fact that the scales of the fiber are larger and flatter and thus form a larger reflecting surface for the light. It may be said that the luster is directly dependent on the size, flatness, and polished condition of the scales, and that any cause that tends to injure the scales will injure the luster of the wool. The luster of wool is often injured in the scouring and drying by the use of too strong or unsuitable detergents and the application of too much heat. The wool of a healthy sheep is lustrous, while that of a sick sheep appears dull and dead. A lustrous wool adds a certain brightness and fresh appearance to the fabric that is manufactured from it.

17. Staple.—By the term **staple,** or **length of staple,** the length of the fiber is meant. Wools are classified as long- and short-stapled wools. Long-stapled wools are known as **combing wools,** and are combed for coarse worsted yarns. Short-stapled wools are known as **clothing wools,** and are carded for the production of woolen yarns and fabrics.

There is a class of wools between the long- and short-stapled wools which has a medium length of staple, and is known as **fine combing wools.** They are first carded and then combed for the production of fine worsted yarns for ladies' dress goods, worsted suitings, etc.; these wools are sometimes classified as **delaine wools,** and in this country may be said to include all combing wools that contain merino blood. The term, therefore, has come to be somewhat synonymous with Ohio wools.

The length of staple varies greatly with the breed of sheep, and it may also be said that, generally, the longer the staple, the coarser and more lustrous is the fiber. The long Scotch "braid" combing wool has a staple of from 14 to 18 inches, and some specimens have been known with a fiber over 20 inches in length. On the other hand, some of the short

clothing wools are hardly more than 2 or 3 inches in length at the most. It is erroneous to suppose that all long-stapled wools are made into worsted, and all short-stapled wools into woolen yarns. Quite short-stapled wool is now made into the fine grades of worsted yarn by means of the French system of mule-spun worsteds.

18. Hygroscopicity. — The hygroscopic property of wool, or its avidity for moisture, is one of its most marked physical properties. Under normal atmospheric conditions, wool will be found to contain about 14 per cent. of its weight of moisture, but if the atmosphere in which the wool is stored is very damp, it may be found to contain as high as from 30 to 50 per cent. of water. Wool brought from a damp storehouse, therefore, into a warm, dry mill will lose in weight. Sometimes the wool in the mill will become so dry as to contain not more than 6 or 8 per cent. of moisture. In this condition it becomes hard to work and is easily electrified, which leads to the necessity of providing some method of artificially regulating the humidity of woolen card, spinning, and weave rooms.

The moisture seems to be contained in the wool fiber in two conditions: first, in a purely mechanical state as a sponge would absorb water; and second, in a somewhat chemical state as a water of hydration. When dried at 100° (centigrade), wool loses on an average 18.25 per cent. in weight. This percentage is allowed as the standard by conditioning houses.

19. Conditioning.—On the continent of Europe and in England so-called **conditioning houses** are established, where the buyer can determine the amount of moisture in given samples of wool. This is a very great convenience and puts the buying and selling of wool on a sound basis. In this country but very little has been done in this direction, but there should be an understanding between the buyer and seller as to the amount of moisture contained not only in loose wools, but also in yarn and tops. This, with official conditioning houses where the exact percentage of moisture

could be determined, would be of mutual advantage to both buyer and seller.

The method of determining the amount of moisture in a sample of wool is first to weigh it carefully, and then to place it in an oven until the moisture is driven off and the sample ceases to become lighter. The amount of loss in weight and the percentage of moisture that the sample contained is then readily determined.

WOOL SUBSTITUTES

20. In manufacturing certain cheap grades of cloth, it is not always possible to use pure wool even of a cheap grade. This leads, therefore, to the use of **recovered fibers,** or wool that has previously been manufactured into cloth and perhaps worn until the garment is no longer serviceable. Under the head of **wool substitutes,** there are three different grades of recovered fibers, each of which is recovered from certain classes of goods and has a distinctive name and character.

21. Shoddy.—The best of the wool substitutes is known under the name of **shoddy,** and consists of the wool fiber recovered from soft woolen rags that have not been milled, or felted; such as flannels, stockings, and knit goods. Shoddy is also made from the hard waste of woolen mills, although this is often used by the mill in connection with their soft waste and new wool. While shoddy is really pure wool, the fiber loses much of its characteristic wool nature in the manufacturing and pulling apart again to regain the fiber.

When viewed under the microscope, the shoddy fiber is seen to differ greatly from the original wool fiber. The distinctive scales or serrations will be seen to have been more or less injured, and may be entirely wanting in places, while the fiber as a whole may appear to have been stretched.

In the process of obtaining shoddy the woolen rags are torn into a fibrous mass or ground up. Although the rags are first oiled and the rag picker is so designed as to perform this office with the least possible injury to the fiber

itself, still the process of reducing the rags to a fibrous condition necessarily injures the fiber and breaks it until it may be but a fraction of its original length. The loss in the length and the destruction of the regular structure of the fiber make shoddy only fit for mixing with new wool for the production of low-class goods. White shoddy is very rare, since the material from which shoddy is made has usually been dyed previously.

FIG. 5

The appearance of a fiber of shoddy greatly magnified is shown in Fig. 5, and it will be noticed that the characteristic structure of the wool fiber is almost entirely destroyed.

22. Mungo.—Mungo is a wool substitute that is even poorer in fiber structure than shoddy. Mungo is the fiber recovered from hard-spun and milled, or felted, woolen and worsted goods. Owing to the hard milling and felting that the fibers have previously undergone, when recovered they are almost destitute of the serrated, or imbricated, structure of a pure wool fiber. There are two varieties of mungo. The better quality is obtained from new rags that accumulate as clippings in tailor shops. The inferior quality is obtained from worn and cast-off broadcloths, suitings, etc. Mungo is used for low-quality woolen goods in connection with a small proportion of new wool to give strength to the yarn.

23. Extract.—Extract is the wool fiber recovered from union goods; that is, cloths that contain wool and also some percentage of vegetable fiber, usually either cotton or linen. In order to recover the wool alone, and not to have the recovered animal fiber mixed with vegetable fibers, it is necessary to resort to a chemical process. This process for the extraction of the vegetable from the animal fibers is generally known as **carbonization,** but sometimes is spoken of as **extraction.**

The process is as follows: The rags are first carefully dusted and cleaned, and then are immersed in a solution of sulphuric acid of from 6° to 10° (Baumé) strength. The acid solution is usually contained in wooden tanks, and the rags are frequently stirred and moved about so as to insure the thorough mixing of the acid and water. When the rags have become thoroughly saturated with the acid, they are removed and the excess of the solution drained off, after which they are dried at a high temperature, varying from 100° to 110° (centigrade).

This process reduces the vegetable matter to a charred or disintegrated form, while the acid has no effect on the wool. The rags are then crushed and dusted in a carbonizing duster or similar machine, and the vegetable matter removed as dust. The recovered wool fiber may now be treated with a dilute soda bath to neutralize the effects of any traces of acid that may remain in the fiber. This process, with some alterations, is in use to a large extent for removing burrs, chaff, shives, and other vegetable matter from pure wool, superseding the older methods of mechanical burr extraction. It will be thoroughly explained later.

SHEEP

24. Classification.—Having dealt somewhat exhaustively with the structure of the wool fiber, it will perhaps be of advantage to consider the different varieties of **sheep** from which wool for textile purposes is obtained. Some naturalists recognize but three varieties of sheep: the *Ovis ammon*, or wild sheep, of Asia and America; the *Ovis musmon*, inhabiting the southern parts of Europe and northern portions of Africa; and the *Ovis aries*, or domestic sheep. These naturalists claim that all other sheep are but varieties of the above, being obtained by crossing and breeding.

The best classification of the sheep of the world is that made by Professor Archer in cooperation with noted manufacturers and naturalists. He divides the sheep that are

useful to man into thirty-two distinct varieties, and groups them geographically as follows:

EUROPE

1. Spanish, or merino, sheep
2. Common sheep
3. Wallachian sheep
4. Crimean sheep

ASIA

1. Hooniah, or black-faced, Tibet sheep
2. Cago
3. Nepal sheep
4. Curumbar, or Mysore, sheep
5. Gārār, or Indian, sheep
6. Dukhun, or Deccan, sheep
7. Morvant de la Chine, or Chinese sheep
8. Shaymbliar sheep
9. Broad-tailed sheep
10. Many-horned sheep
11. Pucha, or Hindustan, sheep
12. Tartary sheep
13. Javanese sheep
14. Barwell sheep
15. Short-tailed sheep of Northern Russia

AFRICA

1. Smooth-haired sheep
2. African sheep
3. Guinea sheep
4. Ceylon sheep
5. Fezzan sheep
6. Congo sheep
7. Angola sheep
8. Yenu, or Goitered, sheep
9. Madagascar sheep
10. Bearded sheep of West Africa
11. Morocco sheep

AMERICA

1. West Indian sheep as found in Jamaica
2. Brazilian sheep

This classification includes all the known varieties of domesticated sheep, the fleeces of many of which are never used in American mills but which are nevertheless interesting from the student's point of view.

25. Spanish Merino.—The Spanish merino, of which large flocks formerly ranged on the mountain slopes of Spain, were in times past acknowledged to produce the best wool in the world, but were imported into Germany by the Elector of Saxony, who by careful breeding improved on the original Spanish merino and produced the Saxony wool, which took its name from the Elector of Saxony, and is often known as the Saxony Electoral wool. These sheep were also crossed with the native Silesian sheep, producing another extremely fine breed, the fleeces of which even surpass the Spanish merino in fineness and weight.

The Spanish merino sheep were introduced into Australia and South Africa and flourished there, until at the present

time the wool from these two places is famous. They were crossed with the various English breeds of sheep, and in many instances the qualities and weights of the fleeces improved. Fig. 6 shows the appearance of a fiber of Spanish merino wool greatly magnified.

26. American Sheep.—Regarding American sheep, it may be said that all of the American breeds of sheep were originally imported. Numerous importations of sheep were made from time to time, including such famous breeds as the Spanish merino, Saxony, and Silesian merino, and also many English breeds, as the Lincoln, Leicester, Cotswold, Southdowns, Oxforddowns, etc.

FIG. 6

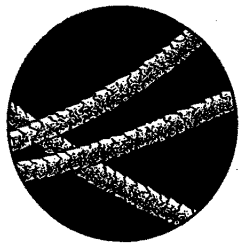

FIG. 7

America seems to be well adapted for the raising of sheep, and many fine flocks are to be found on this continent. The full-blooded American merino produces a fleece that is superior in regard to fineness of fiber, serrations per inch, and other desirable qualities. The merino has been crossed in this country with the common sheep, and in many states, notably Ohio, very desirable cross-bred wools are produced. Fig. 7 shows a view of the fiber of a full-blooded American merino, and the numerous serrations should be noticed.

27. Long-Wool and Short-Wool Sheep.—It should be remembered that many of the long-wool sheep, such as the Lincoln, Cotswold, etc., do not produce such fine and well-imbricated fibers as are shown in the previous illustrations. In fact, it is customary among some naturalists to make two distinct divisions of sheep; namely, **long-wool and short-wool sheep.** The long-wool sheep are larger

and have heavier bodies and white faces. The fleeces are heavier, and the staple longer and less curly. The serrations per inch are less, and the fiber is more lustrous and less heavily yolked.

Short-wool sheep have smaller bodies and lighter fleeces. Their faces are black, and their legs are generally shorter than those of the long-wool sheep. The staple of the wool is shorter and more curly, while the fiber is more imbricated and the fleece more heavily yolked. Fig. 8 shows the fiber of a long-wool sheep greatly magnified. The fibers are those of a Lincoln sheep.

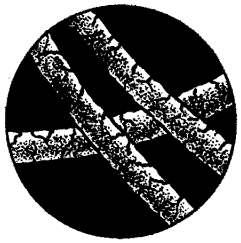

FIG. 8

28. Weight of Fleeces.—In regard to the **weight of fleeces,** it may be said that the weight varies greatly with the breed of sheep and, generally speaking, the long-wool sheep produce heavier fleeces than the short-wool sheep. Fleeces vary in weight from 1 or 2 pounds to 11 or 12 pounds in exceptional cases. An average fleece may be said to weigh from 4 to 6 pounds. Some sheep are bred to heavy fleeces more or less at the expense of the fineness of the fiber, while others are bred for quality alone.

The following table gives the weights of the fleeces of various breeds of sheep, together with other valuable information.

WOOL CONSUMPTION OF AMERICAN MILLS

29. Domestic Wools.—In the United States, the principal wools used are the so-called **territory wools,** which include the wools raised in the states of North and South Dakota, Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Idaho, Washington, Oregon, and California. These wools are largely used in American woolen mills and are generally considered as a good grade of wool. The fleeces of the territory sheep vary from 4 to 7 pounds in weight when in an unwashed state, and lose from 60 to 70 per cent. of their weight in scouring.

Breed	Cross	Quality	Staple	Color	Weight of Fleece Pounds	Kind of Yarn Suited for
Spanish merino . .		Very fine	Short	White	Ram 8 Ewe 5	Woolen
Saxony	Merino and native	Finest	Short	White	5 to 8	Worsted and woolen
Silesian	Merino and native	Finest	Short	White	5 to 8	Worsted and woolen
New South Wales .	Merino and Southdown	Fine		White	$2\frac{1}{2}$	Worsted and woolen
Southdown		Fine	Short	White and gray	3 to 4	Woolen and worsted
Lincoln		Good	Long	White	8 to 9	Worsted
Persian		Medium	Long	White, gray, black, yellow, and brown		Worsted
Donskoi		Coarse	Medium	White and gray		Worsted
Hooniah		Soft and fine	Long			Worsted
Curumbar			Short	White, yellow, gray, brown, and black		Woolen and worsted
Gārār			Short			
Deccan		Coarse	Short			
West Indian . . .		Fine and soft but mixed with hair	Short			Woolen
Morvant de la Chine		Coarse but soft and silky	Short	Yellow		Woolen

The state of Texas also produces a large amount of the so-called **Texas wool.** The Ohio, Pennsylvania, and West Virginia merino and cross-bred wools are largely used in the production of fine worsted yarns. The average weight of American unwashed fleeces is about 7 pounds.

30. Imported Wools.—Of the imported wools, the principal varieties used are the Australian and Cape merino and cross-bred wools for the fine worsted and woolen trade, and such wools as Persian, Donskoi, China, and braid wool for the carpet trade. Large amounts of mohair are also used of both the imported and the domestic fleeces.

31. World's Wool Supply.—Of the world's wool supply, it may be said that the largest amount of wool concentrated and shipped is obtained from a few ports in Australasia, which is without doubt the most important wool-producing region in the world. Much of this wool is sold in London auctions. Europe produces large quantities of wool and South America is a very important source of supply. North America and Asia, also, furnish wool in large amounts, while the fiber is produced in lesser quantities by Africa, Central America, the West Indies, etc.

MOHAIR

32. Although strictly speaking mohair is not wool, yet it is largely used in American mills, and therefore should be mentioned. Mohair is the fleece of the Angora goat, which is indigenous to the mountainous districts of Asia Minor. The hair of this goat more closely approaches sheep's wool in structure than that of any other animal; it is disposed in long, silky staples and possesses a luster that almost rivals that of silk. The staple averages from 6 to 8 inches in length; the fiber is fine and has a very good development of serrations.

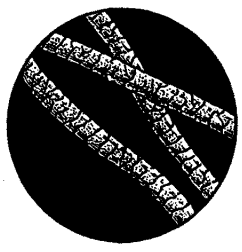

FIG. 9

The Angora goat has been introduced into America, and there are now in this country several very successful flocks, notably in California. The fleece is used for ladies' dress goods and plushes. For pile fabrics, mohair is largely used, as the pile obtained is of great durability. Fig. 9 is an illustration of the mohair fiber greatly magnified.

33. Among other animals, the hair or fleeces of which are used for textile purposes, may be mentioned the Cashmere, or Tibet, goat, which furnishes the material for the famous cashmere shawls, the camel, the kangaroo, the ibex, the llama, the vicugna, from which the vicugna wool is obtained, and the alpaca. The three last-mentioned animals are all varieties of the same species.

WOOL SORTING

INTRODUCTION

34. Not only does the wool vary in regard to quality, staple, fineness, etc. in different breeds of sheep, as has been demonstrated, but it also differs widely in these respects when taken from different parts of a single fleece. Thus arises the necessity of separating the various qualities of wool found on the fleece, in order that they may be used for different grades of cloth. The operation of grading the wool found on the fleece into the different qualities and lengths of staple is called **wool sorting,** while the person who performs the operation is known as a **wool sorter.**

Wool sorting constitutes practically the first operation in the manufacture of a piece of woolen or worsted cloth. It may be said that the wool is sorted into as many different qualities as the mill may require, as fourteen distinct qualities of wool are found on a single fleece by an expert sorter. Ordinarily, there is no necessity for making such a large number of sorts, and in some mills running on low-grade goods, perhaps only two sorts may be made, the edges of

the fleeces only being thrown out; while another mill may sort its fleeces into three or four grades, a first, second, and third quality, with perhaps a little of the coarse breech in a fourth quality. On the other hand, a mill that is running on fine goods and making several grades of cloth may make as many as six or eight sorts from each fleece. It is rarely that more than eight sorts are made, and the general tendency each year is to do less and less wool sorting, since the operation is slow and expensive. However, the coarse, rough breech, or britch, and the skirtings, or edges, of the fleece should always be thrown out, since the yarn spun will be rough and uneven if a mixture of coarse and rough, and fine and soft fibers is used.

35. Wool sorting is a trade learned only by long experience. After working at his trade year after year, the wool sorter acquires a sensitiveness of touch and judgment of the grade of a handful of wool that seems to be instinctive. It is said that an experienced wool sorter is able to sort a fleece with which he is familiar in the dark, telling the different qualities of wool by the feeling alone. The wool sorter learns to judge wool by its **feel**, or **handle**, and by this means alone can tell the degree of softness, fineness, and loftiness of a sample of wool, although he is also guided by the appearance of the staple. In separating the different qualities of wool in a fleece, the sorter is guided by this sense of feeling together with his knowledge of the positions of the different qualities on the fleece.

The tools required by a wool sorter are few, and consist first of all of a wire-covered bench on which he may spread out the fleece and through which loose particles of dirt and any other foreign matter, such as straws, sticks, dust, etc., may fall. He also requires a pair of shears to clip off paint and tarry marks with which the fleece is often marked and as many baskets or boxes as there are sorts to be made.

METHOD OF SORTING

36. The fleece as it comes to the sorter is rolled in a tight bundle and is tied up with either a twisted portion of itself or a string or small rope. In the latter case great care must be taken to remove every portion of the rope, as any particle of vegetable matter in the wool will show a different color when the cloth is dyed. In the winter, when the weather is cold, the fleece may have to be warmed before it can be opened, because the cold weather solidifies the natural grease, or yolk, in the fleece and renders it stiff and hard. As soon as the fleece is warmed, the yolk is started and the fleece becomes soft and pliable. After the fleece is opened, the sorter throws it on the wire bench and proceeds to shake and pick out the vegetable matter, such as burrs, straws, sticks, etc. The back of the sheep forms an indefinite boundary that divides the fleece into two parts. The sorter first separates the fleece along this line into two sections. The next operation is to clip off all paint and tarry marks. In countries where the flocks of sheep run more or less together, it is the custom of some herders to mark their sheep with paint or tar, to distinguish them from sheep of other flocks. This fact accounts for the great number of paint and tarry marks found on fleeces.

The sorter now commences to sort the fleece, being guided by his sense of touch and by the appearance and position of the wool. All coarse, harsh-feeling wool is separated from the fine, soft, and elastic portions, and cast into separate baskets. The finest fiber is that grown on the shoulders and sides, while that of the flanks and lower portions of the animal is of a coarse quality. As a rule, all black or dark-colored locks of wool are separated from the white and placed in one lot, which is usually dyed black. If mixed with the white, the dark-colored wool will, even if in very small quantities, make a *bloom* on white yarns; that is, the yarn will not be pure white, but will have a tinge of color.

It must be understood that there are no definite boundary lines between the different qualities of fiber, but that one

quality merges into another, and a sorter may make three or four, or seven or eight, sorts from the same pile of fleeces according to the needs of the fabrics that are to be made. The poor qualities, which must be separated from the good, include all coarse and harsh-feeling wool, those portions of the fleece that are inclined to be very kempy, tender and ill-grown staples, and also all cotted, or felted, portions, as well as the hard lumps of dirty wool, and the paint and tar marks.

QUALITIES OF WOOL

37. As previously stated, there are fourteen distinct qualities of wool that may be obtained from a single fleece, if carefully sorted. These, according to one authority, are as follows (see Fig. 10):

No. *1* is the shoulder, where the wool is long and fine and grows in close, even staples.

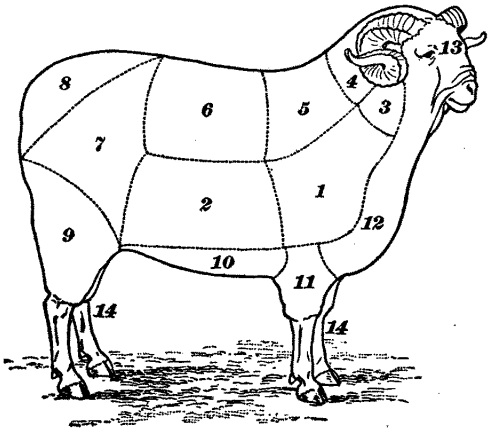

FIG. 10

No. *2* is equally good, but if anything, is inclined to be slightly stronger and the fiber a trifle coarser. The best wool of the fleece is found on these two parts.

No. *3* is the wool that grows on the neck of the sheep, and while the fiber is fine, it is short and liable to contain black or gray hair if the sheep is disposed to their production.

Nos. *4* and *5* produce wool that is somewhat faulty, and the length of the staple is also found to be short.

No. *6*, which covers the loin and back, is still coarser and shorter.

No. *7* produces a wool that is long and strong and hangs in long locks, or staples. It is apt to be very coarse on cross-bred sheep and much resembles the britch.

No. *8* is the britch, or breech, which is the coarsest part of the fleece and is often called *cow-tail* from its resemblance to the coarse tuft of hair on the end of a cow's tail.

No. *9* produces a strong, coarse wool.

No. *10* grows a wool that is short and often dirty from the dirt accumulated when the sheep lies down. It is apt to be finer near the front legs and is commonly known as **brokes.**

No. *11* produces a short and fine wool.

No. *12* is short and fine; the wool is somewhat damaged by rubbing.

No. *13* is the forehead, where the wool is short and coarse and of very little value.

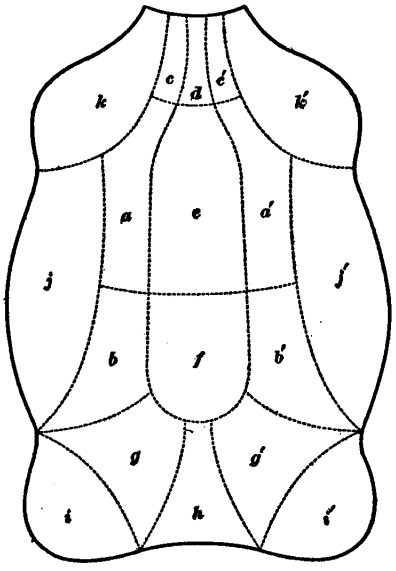

FIG. 11

No. *14* is the legs where the wool is even worse and has no practical value.

When kemps occur in fleeces, they are most liable to be found in Nos. *12* and *8*, although those found on the britch are much longer and stronger.

38. Another excellent division of the qualities of wool in a single fleece is as follows (see Fig. 11): The finest and most evenly grown wool is always found on the shoulders *a*, *a'*.

In some fleeces, this quality extends into *e*, *b*, *b'*, *f* and the quality of the wool at *b* and *b'* is not much inferior, although rather stronger and coarser. These two qualities in the woolen trade would be called **picklock**, and **prime**, or **choice.**

The wool found in position *d* is frequently finer in the staple, but shorter than *a*, *a'* or *b*, *b'* and apt to be defaced by irregular or colored hairs. When free from these defects, it forms a superquality. The qualities *c*, *c'* shade into those on each side of them, and as they form the apex of the shoulders are shorter and less closely grown than *a*, *a'*. The quality of *f* closely resembles that of *b*, *b'*, into which it shades. For many purposes *a*, *a'*, *b*, *b'*, *e*, and *f* are frequently used as one quality.

After passing beyond *f* and back to the flanks of the sheep, the wool becomes long and coarse, the best being found at *g* and *g'*.

At *i*, *i'*, and *h*, the coarsest part of the fleece is reached, where the wool grows in large locks of coarse hair. The former are called the breech, or britch, locks and can only be used for coarse yarns.

39. Perhaps the best division of the different qualities on a fleece is that which separates the varieties of wool as follows:

The Shoulders and Sides.—The wool grown on these parts is remarkable for length and strength of staple, softness of feeling, uniformity of character. It is usually the choicest wool in the fleece.

Lower Part of Back.—This also is wool of a good, sound quality, resembling in staple that obtained from the shoulders and sides, but not so soft and fine in fiber.

Loin and Back.—The staple here is comparatively shorter, the fiber is not so fine, but the wool on the whole is of a true character. In some cases, however, it is liable to be a trifle tender.

Upper Parts of the Legs.—Wool from these parts is of a moderate length, but coarse in fiber and possessing a

disposition to hang in loose, open locks. It is generally sound, but liable to contain vegetable matter.

Upper Portion of the Neck.—The staple of wool clipped from this part of the neck is of an inferior quality, being frequently faulty and irregular in growth as well as full of thorns, twigs, etc.

Central Part of the Back.—This wool is nearly like that obtained from the loins and back, and is rather tender in staple.

The Belly.—This is the wool that runs quite under the sheep between the fore and hind legs. It is short, dirty, poor in quality, and frequently very tender.

Root of Tail.—The fiber is coarse, short, and glossy and the wool often runs with kemps or bright dead hairs.

Lower Parts of the Legs.—This is principally a dirty and greasy wool in which the staple lacks curliness and the fiber fineness. Usually it is burry and contains much vegetable matter.

The Head, Throat, and Chest.—The wools from these parts are classed together, all having the same characteristics. The fiber is stiff, straight, coarse, and covered with fodder. The wool is also apt to be kempy.

The Shins.—This is another short, thick, straight-fibered wool, commonly called **shank.**

WOOL-SORTERS' DISEASE

40. This disease, which frequently attacks wool sorters engaged in sorting dusty wool, especially the Eastern or Asiatic wools, first appears as an ordinary cold accompanied with oppression of the chest, severe headache, and profuse perspiration. The temperature of the patient rises and a cough appears. The respiration becomes harder and the pulse weaker and weaker until in three or four days the man dies. **Wool-sorters' disease** seems to originate in the dust of certain infected wools, which when drawn into the lungs of a person produces a disease that is evidently due to the presence of bacilli.

The worst wool for producing wool-sorters' disease has been found to be what is known as Van mohair. Other wools that are liable to be infected are Turkey mohair, Persian wool, alpaca, camel's hair, and the wool of the Cashmere, or Tibet, goat.

GLOSSARY OF TRADE TERMS USED IN CONNECTION WITH WOOLS

41. Alpaca.—The wool of the Peruvian sheep, or alpaca, which is related to the llama, both belonging to the same genus as the camel.

Angora.—A district in Asia Minor which gives its name to the Angora goat, from which mohair is obtained.

Anthrax.—The scientific name for wool sorters' disease.

Braid Wool.—The fleeces of lustrous- and bright-haired sheep; such as Lincoln, Leicester, Cotswold, etc.

Britch.—Coarse wool from the breech of the sheep.

Brokes.—Short, dirty wool.

Buck Fleece.—The fleece of a ram.

Carbonization.—The chemical process of destroying any vegetable matter found in wool.

Cast.—The fleece of a rough, badly bred sheep.

Classification.—American wools are classified according to condition, staple, and quality.

Clothing Wool.—Clothing wool is the wool of short-haired sheep, which is commonly carded for the production of woolen yarns and fabrics.

Combing Wool.—Long-stapled wools that are combed for producing worsted yarns.

Condition.—This is the state of the fleece as it comes to the market after the first washing. The sheep are driven into the water courses and part of the dirt and grease washed out before the shearing.

Cots.—Bunches of wool that have felted on the sheep's back, due to an absence of yolk, or grease, at the place where the cot occurs.

Delaine Wool.—Delaine wools are those of merino blood prepared for combing by first being carded, and are used for the production of fine and medium worsted yarns. Delaine wools comprise practically all combing wools with a trace of merino blood. In America the term is practically synonymous with Ohio merino and cross-bred wools.

Elasticity.—The lofty, or springy, nature of certain fibers, notably wool.

Extract.—Wool derived from waste woolen materials that have been mixed with vegetable materials, as cotton, linen, etc., either in weaving or otherwise.

Extraction.—This term is synonymous with the term carbonization.

Felting.—A property of wool that enables a number of fibers to join and interlock with one another until they form a compact whole and the fibers cannot be separated. In America, the semiannual clip of portions of Texas and California is sometimes known as felting wool.

Flocks.—The waste of finishing machines in cloth mills, which is again used as a wool substitute to cheapen yarn and make it bulky.

Fulling.—See Felting.

Grease Wool.—Wools that have not been scoured are known as grease wools or are said to be in the grease.

Hog, Hogget, or Teg Fleece.—The first fleece of a sheep that had not been shorn as a lamb, taken when the animal is about 1 year old.

Imbrications.—A word that is practically synonymous with serrations and indicates the serrated, or imbricated, structure of a wool fiber.

Kemp.—A solid, glazed, dead, horny hair found on badly bred fleeces, rarely over $1\frac{1}{2}$ or 2 inches long, which cannot be twisted into the thread in spinning and will not dye the same shade as the rest of the wool.

Lamb's Wool.—The fleece of a sheep taken when the animal is about 6 months old.

Luster.—The glossy, shiny, or bright appearance of certain fibers due largely to the reflection of light from their

surfaces, more particularly noticeable in long and coarse wools, and especially noticeable in alpaca and mohair.

Mohair.—The hair or wool of the Angora goat.

Mungo.—A wool substitute derived from hard-spun and felted woolen and worsted goods.

Noils.—The refuse or short fibers of combing wools that are removed from the longer fiber by the comb during the combing process and which are often used as a wool substitute in connection with pure wool for the production of woolen yarns.

Pulled, or Skin, Wool.—This is the wool of slaughtered or dead sheep. Generally speaking, pulled wool is considered inferior in quality to the wool or fleeces removed from live sheep. This class of wool is not clipped or sheared from the sheep but the skin is plunged in lime water or rubbed with acid, which loosens the roots of the wool, whereupon it can be easily pulled away from the skin. Some varieties of pulled wool felt very easily owing to the fact that the serrations of the fiber are somewhat opened out.

One advantage of pulled wool is that the fibers are whole, whereas in wool that is sheared, unless the process is performed skilfully, there are liable to be short fibers that are cut twice; that is, the shearer in making two successive cuts will cut off the root ends of fibers that were cut from the skin at the preceding time. The sorting of pulled wool is a difficult task, as the wool does not come away from the skin as a whole fleece but in detached portions. The wool is often impregnated with dust and lime and is apt to give rise to wool-sorters' disease.

Quality.—This term denotes the fineness of the fiber and other desirable attributes of first-class wool. In the American worsted trade the qualities are as follows: Picklock; XXX; XX; X; No. 1, or $\frac{1}{2}$-blood; No. 2, or $\frac{3}{8}$-blood; No. 3, or $\frac{1}{4}$-blood; coarse; and common.

Picklock is the finest quality of wool and is supposed to be the wool of the pure-bred Saxony sheep. *XXX* is the first cross of the merino and Saxony. *XX* is the quality of the full-blooded merino. *X* is the three-quarters blooded merino.

Nos. 1, 2, and 3 indicate the variations in purity of blood from the merino and the common sheep.

Scouring.—Wool washing by mechanical and chemical processes.

Scoured Wool.—Wool from which the yolk, or animal grease, has been removed by the process of scouring.

Serrations, or Serratures.—The fine scales, or points, that project from the surface of wool fibers and that interlock with each other in the process of felting.

Skirting.—Separation of the inferior portions of the fleece generally found around the edges and known as skirts, or skirtings.

Shoddy.—The worked-up waste of unmilled, soft woolen and worsted goods.

Shurled Hogget.—The first fleece from a sheep after it has been shorn as a lamb; that is, the fleece of a yearling sheep that had the lamb's wool removed.

Shearlings.—This is a short wool obtained from the skins of sheep shorn just before slaughtering and is largely used by hatters.

Staple.—A lock of wool formed naturally on the sheep's back by a number of fibers clinging together. Wools are classified, according to length of staple, into clothing and combing wools.

Tags.—Short dung locks that are found on fleeces and which are due to improper care and housing of sheep.

Toppings.—These are hard lumps of matted fibers and dirt that must be cut off by the sorter. They are present only to a small extent in well-bred sheep.

Unmerchantable Wool.—Wool poorly washed is known as unmerchantable.

Unwashed Wool.—Unwashed wool is that which comes to the market without a preliminary washing.

Wether Fleeces.—All fleeces shorn from a sheep after the hogget fleece has been removed are known under the general term of wether fleeces.

Yearlings.—The fleeces of 1-year-old sheep.

Yolk.—The natural grease found in the wool of sheep.